International Journal of Food Science and Nutrition
ISSN: 2455-4898
Impact Factor: RJIF 5.14
www.foodsciencejournal.com
Volume 3; Issue 2; March 2018; Page No. 200-206

Effect of roasting on selected nutrient profile and functional properties of chia seeds (*Salvia hispanica*) and optimization of chia seed based instant soup mix

Haripriya A[1*], Aparna NV[2]
[1] Assistant Professor, School of Food Science, MOP Vaishnav College for Women, Chennai, Tamil Nadu, India
[2] MSc. Food Technology and Management, School of Food Science, MOP Vaishnav College for Women, Chennai, Tamil Nadu, India

Abstract
The abundance of scientific evidence on diet having a powerful impact on health and wellbeing has revitalized the curiosity to develop products with added benefits. Current market trends also indicate whooping market for health and functional foods. Chia seeds possess significant anti-inflammatory, antioxidant, cancer preventive and anti-ageing properties. Several epidemiological and experimental reports have proven its medicinal use. Chia seeds can be used to enhance omega-3 fatty acid content in many food products. Hence the study, "Effect of Roasting on selected Nutrient profile and Functional properties of Chia seeds (*Salvia hispanica*) and Optimization of Chia seed powder based Instant Soup Mix" was carried out. In this study, the Chia seeds were subjected to roasting and its impact on nutrient profile and functional properties were analyzed. A convenience food - ready to cook -Instant soup mix, with incorporation of chia seeds powder at 5%, 10% and 15% levels was developed. Sensory parameters of the soup mix prepared were analyzed by a panel of semi trained members in a 9 point hedonic scale. There was a significant difference in the proximate composition of the untreated and roasted chia seed flour. Sensory analysis of the chia soup revealed that all the samples ranked similar for all the attributes. The study reveals that there is a possibility for the formulation of an instant soup mix with chia seed which has good nutritional profile and acceptable sensory attributes.

Keywords: chia (*Salvia hispanica* L.), dry roasting, functional properties

1. Introduction
Functional foods have gained tremendous attention worldwide over the past few years due to the wave of healthy lifestyle changes. One of the reasons for the interest to shift to a healthier lifestyle is the increasing number of people suffering from cardiovascular diseases (CVDs), high blood pressure, obesity, diabetes, and other related diseases. These conditions are commonly due to inactive lifestyle and poor diet where the food consumed daily contains high amounts of saturated fatty acids (SFAs) (Ayerza, 2002) [1]. More recently, chia seeds are regaining the spotlight for their suspected nutritional benefits and have even been deemed as a super food (Eat Right - Academy of Nutrition and Dietetics, 2013) [2].

Chia (*Salvia hispanica* L.) is an annual herbaceous plant that belongs to the Lamiaceae family. Chia (*Salvia hispanica* L.) is a desert plant that was cultivated for centuries by the Aztecs of ancient Mexico. Chia seeds were a very important crop of the Aztec people, along with corn, as they incorporated these seeds into their daily diet (Ayerza and Coates, 2011) [3]. Name "chia" is derived from Aztec word "chian" meaning oily. The word "chia" creates a part of name of present Mexican state Chiapas, where the chia is produced in the highest volume. Chia seeds were eaten in Aztec epoch alone or blended with cereals, in whole or milled into flour. It is now widely cultivated and commercialized for its (omega) ω-3 alpha-linolenic acid (ALA) content and antioxidant properties (Jamboonsri *et al*, 2012) [4].

The seed color varies from black, grey and black spotted to white, and the shape is oval with size ranging from 1 to 2mm (Bresson *et al*, 2009) [5]. The seeds when soaked in water will form a copious mucilaginous polysaccharide envelope around the seed (Gentry *et al*, 1988) [6]. According to the hydrophilic character, they absorb amount of water corresponding to volume increase up to 12 times (Moroni *et al*, 2010) [7]. Chia seed gum has the potential for industrial use because of its slimy properties, evident even at very low concentration (Segura –Campos *et al*, 2014) [8].

Chia seed is composed of protein (15–25%), fats (30– 33%), carbohydrates (26–41%), high dietary fiber (18–30%), ash (4-5%), minerals, vitamins, and dry matter (90–93%). It also contains a high amount of antioxidants (Ixtaina *et al*, 2008) [9]. Heavy metal analysis showed that chia seed contains them at safe levels, not exceeding the maximum metal levels for food safety, and the seed is also free from mycotoxins (Bresson *et al*, 2009) [5]. Another key feature of chia seed is that it does not contain gluten (Bueno *et al*, 2010) [10]. Chia seeds contain up to 39% of oil, which has the highest known content of *α*-linolenic acid, up to 68% (Ayerza and Coates,2000) [11].

In addition, chia seed and oil contain a rich pool of natural antioxidants such as tocopherols, phytosterols, carotenoids and phenolic compounds, including chlorogenic acid, caffeic acid, myricetin, quercetin and kaempferol which protects consumers against many diseases and also promotes beneficial effects on human health (Ixtaina *et al*, 2011 [12]. Capitani *et al*, 2012 [13]; Reyes-Caudillo *et al*, 2008 [14]. Nijveldt *et al*, 2001 [15].

Chia flour after processing could be stored for many years and could be used as high-energy food. *Chianpinolli* is a common

practice of roasting and grinding the seeds to produce flour which resembles the processing of maize kernels. This processed Chia seeds could be used in the preparation of products like tamales, tortillas and several other Aztec beverages known as Chiantoles (Cahill and Provance, 2002) [16]. Chia is commonly consumed as salad from chia sprout, in beverages, cereals, and salad dressing from the seed, or it is eaten raw (Rend´on-Villalobos *et al*, 2012 [17]; Baughman and Jamieson,1929 [18]).

Hence, the current study was undertaken to study the effect of roasting on selected nutrient profile and functional properties of Chia seeds and to optimize Chia seed based instant soup mix.

2. Materials and Methods

Chia seeds used in the present study were procured from local super market. After cleaning, one part of the seeds were roasted in a griddle for 5-7 min, cooled and ground to fine powder.

2.1 Experimental Analysis

The following tests were conducted for the plain and roasted chia seed flour

2.1.1 Nutrient composition

Moisture, Ash, Crude Fibre, Protein, Fat, Vitamin C, Iron, Calcium, Phosphorus **(**AOAC, 2000), [19] Total carbohydrates (FAO, 2003), [20] Total Calorie (James, 1995), [21] and Total phenols (Singleton and Slinkard, 1977) [22]

2.1.2 Functional properties

Bulk Density, Water Absorption, Oil Absorption, Swelling Power, Emulsion Stability (AOAC, 2006) [23].

2.2 Formulation of Chia seed incorporated instant soup mix

A ready to make Instant Soup mix was developed and chia seed powder (untreated and roasted at 5%, 10% and 15%) was incorporated replacing the corn starch as thickener.

Table 1: Product code for Chia seed incorporated Instant Soup Mix

CS	Control Soup (Without Chia seed incorporation)
UTS1	Soup incorporated with 5% untreated chia seed powder
UTS2	Soup incorporated with 10% untreated chia seed powder
UTS3	Soup incorporated with 15% untreated chia seed powder
RGS1	Soup incorporated with 5% roasted chia seed powder
RGS2	Soup incorporated with 10% roasted chia seed powder
RGS3	Soup incorporated with 15% roasted chia seed powder

Table 2: Composition of Chia seed incorporated instant soup mix

Ingredients	Quantity (per 50g)
Tomato powder	25g
Onion powder	10g
Garlic powder	1.5g
Ginger powder	1.5g
Corn flour	5g
Salt	5g
Pepper powder	2g

Chia seed powder (Untreated, Roasted) were incorporated at 5%, 10% and 15% levels instead of Corn flour

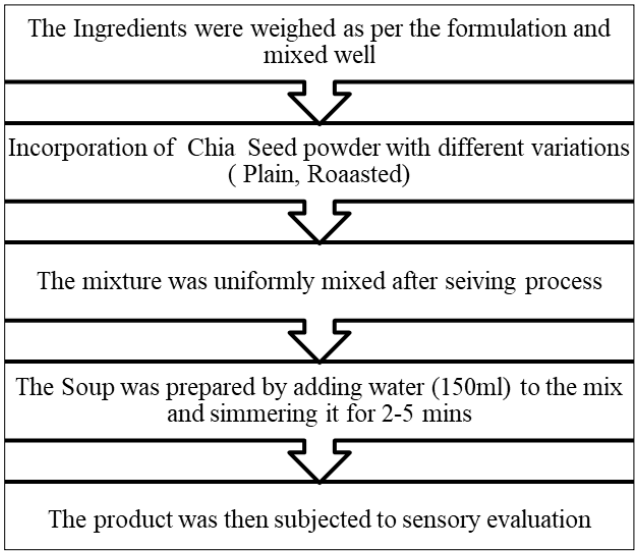

Fig 1: Preparation of instant Chia soup mix

2.3 Sensory analysis

Sensory evaluation was carried out for all the variations of soup mix on a 9 – point hedonic scale rating by 15 semi-trained panellists. Each panellist was given a sensory evaluation sheet and the soup prepared with the RTC mix developed were rated for parameters such as colour, flavour, consistency, taste, mouth feel, after taste and overall acceptability (Peryam and Pilgrim,1957) [24]

2.4 Statistical analysis

All the experimental analysis was carried out in triplicates. Data were reported as mean and standard deviation. Paired t test was carried out to compare the significant difference between the plain flour and the dry roasted. One way ANOVA was carried out to analyze any significant difference in the sensory attributes of the soup mix variations. Data analysis was done using SPSS version 20.0.

3. Results and Discussion

3.1 Experimental analysis

3.1.1 Nutrient composition

Moisture

The moisture content of the flour is indicative of the dry matter in food. The low moisture content is an index of stability, quality and increased shelf life of seeds (Marangoni and Alli, 1988).[25] The moisture content of untreated and roasted chia seed powders were 4.3±0.26% and 4.1±0.1% respectively. There was a 4.65 % decrease in moisture content on dry roasting. However statistically significant difference was not observed. The results were in accordance with the findings of Weber *et.al* (1991) [26] stating the moisture content of chia seed as 4.00±0.12 %.

Ash Content

The ash content of untreated and roasted chia seed powder were 2.76±0.07% and 2.50 ±0.36% respectively. There was a 9.42% decrease in ash content after roasting but it is not

statistically significant. A study reported the ash content of untreated chia seed powder to be 5.15% (Weber *et.al*, 1991). [26] This difference could be due to the variation in Chia samples used for the study.

Table 3: Nutrient Composition of Chia seed powder (untreated, roasted)

Sample/ Parameters	Untreated Chia seed powder	Roasted Chia seed Powder
Moisture content (%)	4.3±0.26	4.1±0.1^{NS}(-4.65) [1]
Total Ash (%)	2.76±0.07	2.5±0.36 ^{NS}(-9.42) [1]
Total Fat (%)	36.12±0.72	34.86±1.21 ^{NS}(-3.48) [1]
Protein (g/100g)	33.4±0.22	40.4±0.21*(20.9) [1]
Total calories(Kcal/100g)	670.24	687.74 (2.61) [1]
Total Fibre content (g/100g)	21±0.5	24.7±0.45 ^{NS} (17.61) [1]
Total Carbohydrate (g/100g) By difference	50.14±0.20	53.21±0.58 ^{NS} (6.12) [1]
Vitamin C (mg/100g)	32.4±0.05	37.3±0.25* (15.12) [1]
Iron (mg/100g)	5.2± 0.26	5.88±0.15 ^{NS} (10.76) [1]
Calcium(mg/100g)	117.3± 1.52	119.6± 1.10 ^{NS} (1.96) [1]
Phosphorus(mg/100g)	337.6± 2.70	285.4± 1.30* (-15.46)[1]

Values are Mean ± SD (triplicate samples)
[1] depicts the percent increase or decrease between Untreated and dry roasted Chia Seed powder
* Significant difference ($p<0.05$) on comparing Untreated and dry roasted Chia seed powder
^{NS} Depicts no significant difference

Fat content
Chia seeds contain on an average, 40 per cent of their total weight as oil. Their oil contains nearly 60 per cent omega-3 unsaturated fatty acids (Reales *et al*, 2004) [27]. The fat content of untreated, and roasted chia seed powders were found to be 36.12±0.72%, and 34.86±1.21 % respectively. The results are in accordance with the previous study reporting a fat content of 34.05±0.52 % in chia seed powder (Weber *et.al*, 1991) [26]. Jamboonsri *et al*, (2012) [4] reported that *Salvia hispanica* contain on an average 30.74 per cent of total lipids. There was a no significant impact in fat content on dry roasting.

Protein content
Chia seeds are found to contain high amount of protein. The average protein content varies from 15per cent to 23 per cent according to the location where the seeds have been grown. Chia seeds (per 100g) contain higher amount of protein (16.54 g) as compared to other grains like wheat (11.8 g), oats (13.6 g), barley (11.5 g), rice (6.8 g) and corn (11.1 g) (Reyes-Caudillo *et al*, 2008 [14] ; Jamboonsri *et al*, 2012 [4]; Peiretti and Gai, 2009) [28].
Bushway *et al* (1984) [29] reported a protein content of 23.6% for *Salvia hispanica.* The protein content of untreated and roasted chia seed powder were 32.4±0.22% and 40.4±0.21% respectively. Coelho *et.al* (2014) [30] reported the protein content of chia seed powder to be 18%.Roasting technology resulted in the increase in the protein content of the chia seed.In the current study, there was a significant($p<0.05$) increase by 20.9% in the protein content of chia seeds on dry roasting.

Total carbohydrate
The total carbohydrate content of untreated and dry roasted chia seed powder were 50.14±0.20% and 53.25±0.58 respectively. There was a 6.12% increase in the carbohydrate content of chia seeds on dry roasting however the difference is not statistically significant. Weber *et.al* (1991) [26] reported a total carbohydrate content of 41.80 % in Chia seeds.

Total calories
The total calorie content of untreated and dry roasted chia seed powder (Table 3) was 670.24 Kcal and 687.74.Kcal respectively. There was a 2.61 % increase in the calorie content of chia seeds on dry roasting. A study reported a total calorie content of 550Kcal /100g in Chia seeds (Weber *et.al*, 1991). [26] Coelho (2014) [30] reported a caloric value of 431 Kcal/100g in chia seeds. Coelho[30] associates the caloric value with its high levels of lipids. Jin *et al* (2010) [31] reported a caloric value of 562 Kcal/100 g for chia seed.

Total fibre content
The total dietary fiber content of chia seeds ranges from 36 to 40 g per 100g which is much higher than that present in several grains, vegetables and fruits such as corns, carrot, spinach, banana, pear, apple, kiwi (Reales *et al*, 2004).[27] Insoluble and soluble dietary fiber vary from 23 to 46 per cent and 2.5 to7.1 per cent respectively**.** Chia contains about 5 per cent mucilage which can also act as soluble fiber. The insoluble dietary fibre of chia is capable of retaining water several times of its weight during hydration and thus provides bulk and prolongs the gastro-intestinal transit time(Simopoulos, 2002) [32].
The total crude fibre content of untreated and roasted chia seed powders were 21±0.5 g/100g and 24.7±0.45 g/100g respectively. There was a 17.61% increase in the fibre content of chia seeds on dry roasting. The results are in accordance with the researcher Coelho (2014) [30] who reported a fiber content of 22.1 g/100 g.

Vitamin C
The vitamin C content of untreated and roasted chia seed powders were 32.4±0.05mg/100g, and 37.3±0.25 mg/100g respectively. There was a 15.12% increase in the Vitamin C content in the chia seed on dry roasting, which was statistically significant ($p<0.05$).

Iron conatent

The iron content of untreated and roasted chia seeds (Table 3) were 5.2±0.26mg/100g, and 5.88±0.15mg/100g respectively. The result is lower than the value reported (7.72mg/100g) by USDA (2011) [33]. There was a 10.76% increase in iron content of chia seed powder on dry roasting.

Calcium and phosphorus content

Chia contains six times more calcium, eleven times more phosphorus and four times more potassium than 100g of milk (Betti *et al* 2009[34]; Ayerza and Coates, 2004[35]). The calcium content of untreated and roasted chia seeds were 117.3±1.52 mg/100g and 119.6±1.10 mg/100g respectively. There was a 1.96 % increase in the calcium content on dry roasting. The result is lower than the value reported (631 mg/100g) by USDA (2011) [33]. The phosphorus content of untreated and roasted chia seeds were 337.6± 2.70 mg/100g and 285.4± 1.30 mg/100g respectively. There was a significant ($p<0.05$) 15.46 % decrease in the phosphorus in dry roasted chia seed powder compared to the untreated. The value obtained is much lower than the value reported (860 mg/100g) by USDA (2011) [33].

Different ecosystems have variable significant effects on the nutrient composition of *Salvia hispanica.* The environmental factors which have been found to influence composition of chia seeds include temperature, light, soil composition and type/variety (Ixtaina *et al*, 2008) [9]. This reason could be attributed to the higher value of protein and lower value of iron, calcium and phosphorus reported in the current study.

Total phenolic compounds

Table 4: Poly phenol content of Chia seed powder

Sample/ Parameters	Untreated Chia Seed powder	Roasted Chia seed powder
Total Phenolic Compounds (mg/100g expressed as TAE-Tannic Acid Equivalent)	43.19	45.79 (6.01)

Polyphenols are well known to be important nutraceutical having antioxidant properties. Chia seeds are high in phenolic compounds which have been scientifically proven to exhibit free radical scavenging properties. The total phenolic content of the untreated and roasted chia seed powder were found to be 43.19 mg/100g, TAE and 45.79 mg/100g, TAE respectively. There was a 6.01 % increase in the total phenolic content of the chia seed powder on dry roasting. Increase in total phenolic content on roasting maybe due to increase in the extractability of bound phenolics by the thermal degradation of cellular constituents.

Chia seed from two different regions in Mexico showed values between 0.88 and 0.92 mg GAE/g (Reyes-Caudillo *et al*, 2008) [14]. Roasting improve the nutraceutical property of Chia seed by increasing its content in phenolic compounds and also its antioxidant activities

3.1.2 Functional properties of chia seed powders

Table 5: Functional properties of untreated and roasted Chia seed powders

Sample/ Parameters	Untreated Chia Seed powder	Roasted Chia Cress
Bulk Density (g cm^{-3})	0.8±0.00	0.9±0.09 ^{NS} (12.5)[1]
Oil absorption capacity(ml/g)	1.8± 0.2	1.2 ±0.25 ^{NS} (-33) [1]
Swelling Capacity (%)	8.5 ±1.74	6.3± 0.53 ^{NS} (-25.88) [1]
Water absorption capacity(ml/g)	5.2±2.56	2.7± 0.51 ^{NS} (-48) [1]
Emulsion Capacity	42 ±0.76	38.8±0.92 ^{NS} (-7.61) [1]

Values are Mean ± SD (triplicate samples

[1] depicts the percent increase or decrease between Untreated and dry roasted Chia Seed powder

* Significant difference ($p<0.05$) on comparing Untreated and dry roasted Chia seed powder

^{NS} Depicts no significant difference

Bulk density

Bulk density is generally affected by the particle size and density of the flour and it is very important in determining the packaging requirement, material handling and application in wet processing in food industry (Karuna *et al*, 1996) [36]. The bulking property of a powder alters according to the preparation methods, different treatments administered and storage. The density of the processed products or the uniqueness of its container determines the amount and strength of packaging material (Wilhelm *et al*, 2004) [37].

The Bulk density of untreated and roasted chia seeds were found to be 0.8 gcm^{-3}, and 0.9±0.09 g cm^{-3} respectively.There was a 12.5% increase in bulk density on dry roasting. Ixtaina *et al*, (2008) [9] reported a bulk density of 0.722 (g cm^{-3}) for black chia seeds and 0.667 (g cm^{-3}) for white chia seeds.

Water absorption capacity

The water and oil binding capacity of food protein depend upon the intrinsic factors like amino acid composition, protein conformation and surface polarity or hydrophobicity. WAC of flour is closely linked to both amount of amino acids in different flours and availability of proteins functional groups in flour (Kouakou *et al*, 2013) [38].

The water absorption levels of untreated and roasted chia seeds were 5.2±0.25 ml/g, and 2.7 ± 0.30 ml/g respectively. There was a 48 % decrease in water absorption on dry roasting of chia seed powder. The high water retention capacity of chia seed measured in this study illustrates its high fiber content.

WHC is the ability of a moist material to retain water when subjected to an external centrifugal gravity force or compression (Alfredo *et al*, 2009) [39]. The chia defatted meals exhibited a WHC of 9.2 to 10.13 g/g. The high WHC values can be attributed to the presence of mucilage in the chia seeds,

which has excellent water retention properties (Capitani *et al*, 2012) [13].

Alfredo *et al* (2009) [39] reported that the fiber structure and high proportions of hemicellulose and lignin may contribute to the high WHC values obtained for chia seeds and their derivatives. The WHC results of chia defatted meal suggest the application in products requiring hydration, viscosity development and conservation of freshness, such as baked goods. Coelho *et al* (2014) [30] reported a water retention capacity of 24.0 ± 0.879 g.g-1.

Oil absorption capacity

Oil absorption capacity (OAC) is an essential property to develop novel food products and store them for a long period. Flavor and mouth feel of food depends on the fat molecules present in the flour to some extent (Kinsella, 1976) [40]. The oil absorption capacity of untreated and roasted chia seed seeds were 0.9±0.26 ml/g, & 0.8±0.32 ml/g respectively. There was a 33% decrease in oil absorption capacity of chia seed powders on dry roasting.

Alfredo *et al* (2009) [39] reported that the fiber-rich chia fraction showed a low oil-holding capacity (2.2 g/g). The OHC of defatted chia meals is considered to be low when compared with soya (3.66 g/g) (Chau and Huang, 2003)[41]and high when compared with the values of 1.03, 2.17 and 1.61 g/g reported for defatted seed flours of black gram, peanut and soybean, respectively(Joshi *et al*, 2015) [42].

Swelling power

Swelling capacity is the volume of expansion of molecule due to the consumption of water up to a level where the colloidal suspension is complete (Ayernor and Ocloo, 2002) [43]. In addition; bonding forces and starch species present in the flour determine the degree of swelling and solubility of the flour.

The swelling capacity of untreated and roasted chia seed powder were recorded as, 8.5±1.74% and 6.3±0.53% respectively. There was a significant ($p<0.05$) 25.88% decrease in swelling capacity on dry roasted sample.

Emulsion capacity

The emulsion capacity of untreated and roasted chia seed powder was recorded as 42 ±0.76% and 38.8±0.92 % respectively. There was a 7.61 % decrease in emulsion capacity on dry roasting the chia seeds. The high protein content of the chia meals may contribute to the emulsifying activity, since most proteins are strong emulsifying agents.

Alfredo *et al*., (2009) [39] stated that in comparison with other fiber sources (soybean, wheat, maze, wheat hulls), the fiber-rich fraction in Chia had higher water holding, absorption, and organic-molecule absorption with high emulsifying activity (53.26 mL/100 mL) and emulsion stability (94.84 mL/100 mL) Therefore, it could be well applied in desserts or cookies (Alfredo *et al*, (2009); Capitani *et al*, 2012) [13, 39].

There was no statistically significant difference between the roasted and untreated samples in their functional properties.

3.2 Product development- Chia seed powder incorporated soup mix

A ready to make Instant Soup mix was developed and chia seed powder (untreated and roasted at 5%, 10% and 15%) was incorporated replacing the corn starch as thickener. Table 1 depicts the product code assigned for Chia seed incorporated Instant Soup mix. Table 2 gives the composition of the soup mix prepared. Fig 1 outlines the method of preparation of the soup mix.

3.3 Sensory parameters of chia seeds incorporated instant soup mix

Sensory evaluation involves the measurement and interpretation of the sensory characteristics of food products through the use of human subjects acting as judges. Sensory evaluation brings valuable information on quality characteristics. The comparison of the sensory attributes-appearance, colour, taste, flavor, mouth feel, consistency, after taste and overall acceptability were made among the untreated and roasted chia seed samples with different levels of incorporations (5%, 10% and 15%) for the Instant Soup Mix prepared.

One way ANOVA analysis for the sensory attributes of the chia seed instant soups revealed that there is a no significant difference ($p<0.05$) among the experimental samples.

Among the soup mix prepared from untreated and roasted chia seed, the overall acceptability ranked similar to all the products. Most of the rankings were 7 – which corresponds to like moderately as its description. The product can be improvised further and tried as mixed vegetable soup mix for better acceptance

Table 6: Sensory Scores for Chia seed incorporated Instant Soup Mix

Parameters/ Product code	CS	UGS1	UGS2	UGS3	RGS1	RGS2	RGS3
Appearance	7.7±0.57	7.6 ±0.48	7.5 ±0.51	7.7± 0.59	7.6± 0.61	7.6 ±0.63	7.4± 0.51
Color	7.8±0.38	7.8± 0.41	7.7 ±0.45	7.2 ±0.10	7.6± 0.48	7.7 ± 0.45	7.6 ±0.50
Taste	7.1± 0.61	7± 0.84	7.0± 0.45	7.2± 0.56	7.2± 0.94	7 0.±75	6.8 ±0.63
Flavour	7.2± 0.77	7.4± 0.63	7.3± 0.48	6.7± 0.59	7.2± 0.59	7.1± 0.63	7.1± 0.35
Mouthfeel	7.2± 1.01	7.0±0.88	7.1± 0.51	7.2± 0.59	7.2 ±0.67	7.2 ±0.67	7.1 ±0.51
Consistency	7.2± 0.70	6.8± 0.74	7± 0.37	7.2± 0.79	6.9± 0.59	6.9± 0.57	7.3± 0.48
After taste	7.2± 0.79	7.2± 0.86	7.3± 0.61	7.2± 0.67	7.3± 0.72	7.2± 0.70	7.0± 0.70
Overall acceptability	7.4± 0.63	7.3± 0.72	7.2± 0.45	7.3 ±0.5	7.4± 0.63	7.2± 0.45	7.4± 0.51

Values are Mean ± SD (15 respondents)

4. Conclusion

Chia seeds *or Salvia hispanica* was used as food as early as in 3500 BC and this ancestral seed has been known for its medicinal and nutritional properties from ancient time because of its high content of omega-3 fatty acids. On studying the impact of pre- treatment – dry roasting on Chia seed, it can be

concluded that there is a significant increase in the protein content. The incorporation of chia flour in the formulation of soup mix can be justified as it has a good nutrient profile and beneficial nutraceutical properties. The current study recommends the usage of Chia seed as plain flour or roasted floor in the preparation of soups. It can be explored further for new functional food formulations and health drink preparations.

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